

# NTR5105P

## Power MOSFET

–60 V, –211 mA, Single P–Channel  
SOT–23 Package

### Features

- Trench Technology
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Small Signal Load Switch
- Analog Switch

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                         |                        |                       | Symbol                               | Value      | Unit |
|-------------------------------------------------------------------|------------------------|-----------------------|--------------------------------------|------------|------|
| Drain-to-Source Voltage                                           |                        |                       | V <sub>DSS</sub>                     | −60        | V    |
| Gate-to-Source Voltage                                            |                        |                       | V <sub>GS</sub>                      | ±20        | V    |
| Continuous Drain Current (Note 1)                                 | Steady State           | T <sub>A</sub> = 25°C | I <sub>D</sub>                       | −196       | mA   |
|                                                                   |                        | T <sub>A</sub> = 85°C |                                      | −141       |      |
|                                                                   | t ≤ 5 s                | T <sub>A</sub> = 25°C |                                      | −211       |      |
|                                                                   |                        | T <sub>A</sub> = 85°C |                                      | −152       |      |
| Power Dissipation (Note 1)                                        | Steady State           | T <sub>A</sub> = 25°C | P <sub>D</sub>                       | 347        | mW   |
|                                                                   | t ≤ 5 s                |                       |                                      | 403        |      |
| Pulsed Drain Current                                              | t <sub>p</sub> = 10 μs |                       | I <sub>DM</sub>                      | −784       | A    |
| Operating Junction and Storage Temperature                        |                        |                       | T <sub>J</sub> ,<br>T <sub>stg</sub> | −55 to 150 | °C   |
| Source Current (Body Diode) (Note 2)                              |                        |                       | I <sub>S</sub>                       | −347       | mA   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                        |                       | T <sub>L</sub>                       | 260        | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE RATINGS

| Parameter                                           | Symbol          | Max | Unit               |
|-----------------------------------------------------|-----------------|-----|--------------------|
| Junction–to–Ambient – Steady State (Note 1)         | $R_{\theta JA}$ | 360 | $^\circ\text{C/W}$ |
| Junction–to–Ambient – $t \leq 5 \text{ s}$ (Note 1) | $R_{\theta JA}$ | 310 | $^\circ\text{C/W}$ |

1. Surface–mounted on FR4 board using 1 in. sq. pad size (Cu area – 1.127 in. sq. [2 oz.] including traces).
2. Surface–mounted on FR4 board using the minimum recommended pad size of 30 mm<sup>2</sup>, 2 oz. Cu pad.

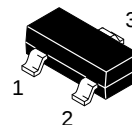
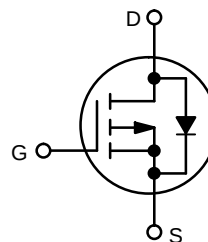


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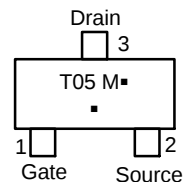
| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| –60 V         | 5 $\Omega$ @ –10 V       | –211 mA           |
|               | 6 $\Omega$ @ –4.5 V      |                   |

### P–Channel



SOT–23  
CASE 318  
STYLE 21

### MARKING DIAGRAM/ PIN ASSIGNMENT



T05 = Device Code  
M = Date Code\*  
■ = Pb–Free Package

(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

| Device      | Package             | Shipping†          |
|-------------|---------------------|--------------------|
| NTR5105PT1G | SOT–23<br>(Pb–Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NTR5105P

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                           |                   |                                                                   |                           |     |           |                            |
|-----------------------------------------------------------|-------------------|-------------------------------------------------------------------|---------------------------|-----|-----------|----------------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$              | -60                       |     |           | V                          |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | Reference to $25^\circ\text{C}$ , $I_D = -250\text{ }\mu\text{A}$ |                           | 6.5 |           | $\text{mV}/^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -60\text{ V}$                      | $T_J = 25^\circ\text{C}$  |     | -1.0      | $\mu\text{A}$              |
|                                                           |                   |                                                                   | $T_J = 125^\circ\text{C}$ |     | -10       |                            |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$                   |                           |     | $\pm 100$ | nA                         |

### ON CHARACTERISTICS (Note 3)

|                                             |                  |                                                  |      |     |      |                            |
|---------------------------------------------|------------------|--------------------------------------------------|------|-----|------|----------------------------|
| Gate Threshold Voltage                      | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\text{ }\mu\text{A}$ | -1.0 |     | -3.0 | V                          |
| Negative Threshold Temperature Co-efficient | $V_{GS(TH)}/T_J$ |                                                  |      | 4.2 |      | $\text{mV}/^\circ\text{C}$ |
| Drain-to-Source On-Resistance               | $R_{DS(on)}$     | $V_{GS} = -10\text{ V}, I_D = -100\text{ mA}$    |      | 1.6 | 5.0  | $\Omega$                   |
|                                             |                  | $V_{GS} = -4.5\text{ V}, I_D = -100\text{ mA}$   |      | 2.2 | 6.0  |                            |
| Forward Transconductance                    | $g_{FS}$         | $V_{DS} = -5.0\text{ V}, I_D = -100\text{ mA}$   |      | 227 |      | mS                         |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |                                                                     |  |      |  |    |
|------------------------------|--------------|---------------------------------------------------------------------|--|------|--|----|
| Input Capacitance            | $C_{iss}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -25\text{ V}$    |  | 30.3 |  | pF |
| Output Capacitance           | $C_{oss}$    |                                                                     |  | 4.7  |  |    |
| Reverse Transfer Capacitance | $C_{rss}$    |                                                                     |  | 3.2  |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -5\text{ V}, V_{DS} = -25\text{ V}, I_D = -100\text{ mA}$ |  | 1.0  |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                     |  | 0.2  |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                     |  | 0.4  |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                     |  | 0.3  |  |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |              |                                                                                            |  |      |  |    |
|---------------------|--------------|--------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = -5\text{ V}, V_{DD} = -48\text{ V}, I_D = -100\text{ mA}, R_G = 1\text{ }\Omega$ |  | 5.8  |  | ns |
| Rise Time           | $t_r$        |                                                                                            |  | 4.0  |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                            |  | 8.8  |  |    |
| Fall Time           | $t_f$        |                                                                                            |  | 12.8 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |          |                                             |                           |  |      |     |   |
|-----------------------|----------|---------------------------------------------|---------------------------|--|------|-----|---|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = -100\text{ mA}$ | $T_J = 25^\circ\text{C}$  |  | 0.78 | 1.0 | V |
|                       |          |                                             | $T_J = 125^\circ\text{C}$ |  | 0.59 |     |   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

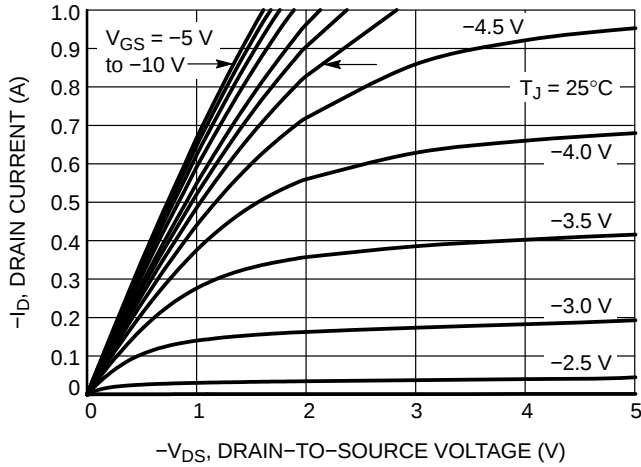


Figure 1. On-Region Characteristics

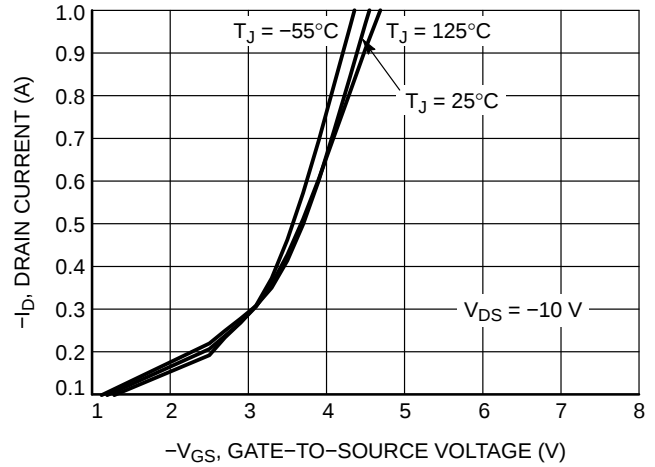


Figure 2. Transfer Characteristics

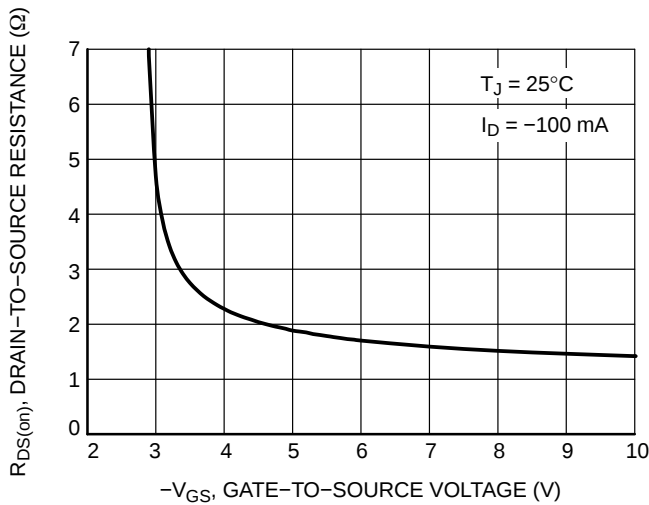


Figure 3. On-Resistance vs. Gate-to-Source Voltage

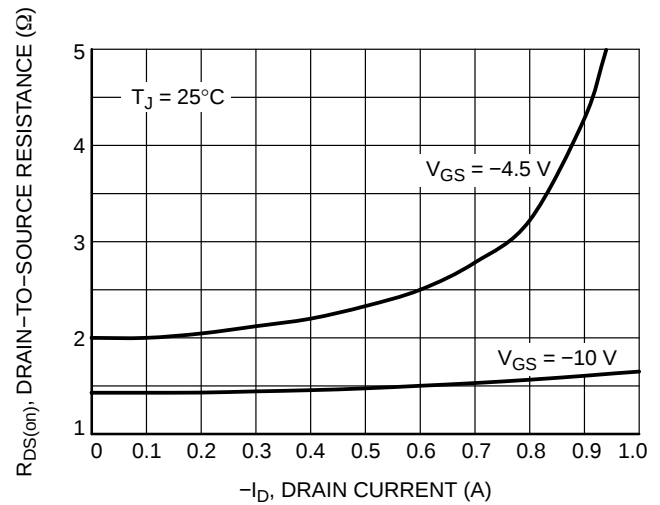


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

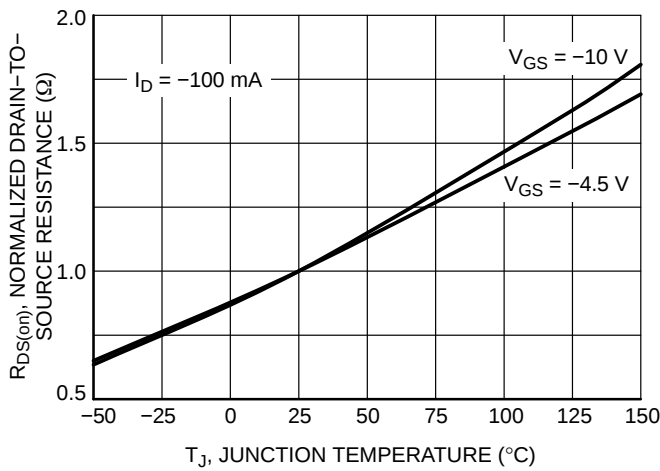


Figure 5. On-Resistance Variation with Temperature

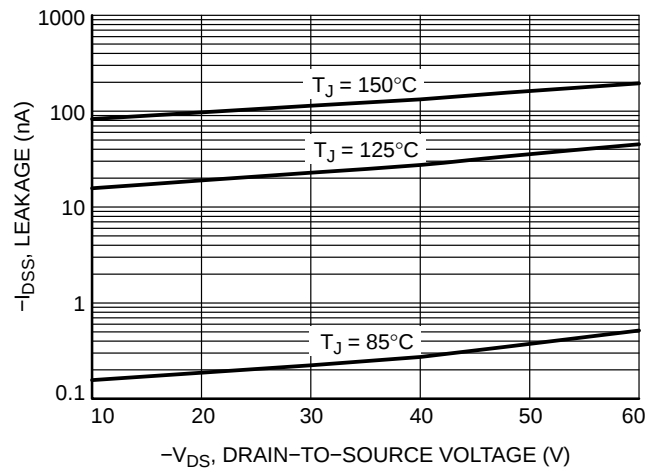


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

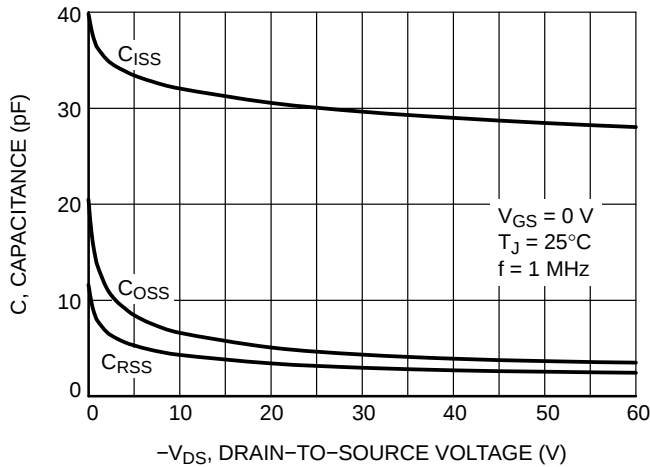


Figure 7. Capacitance Variation

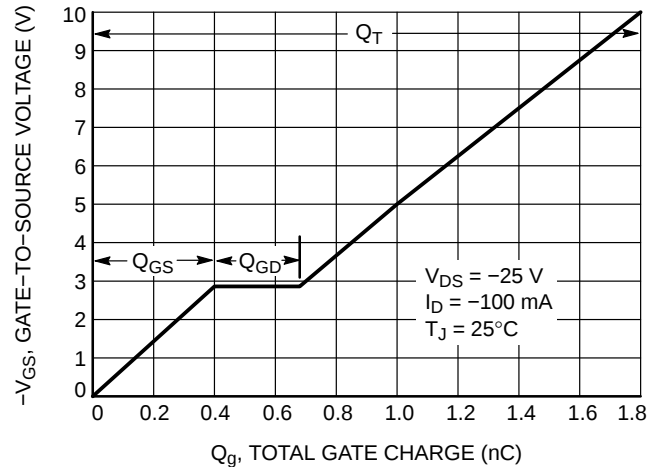


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

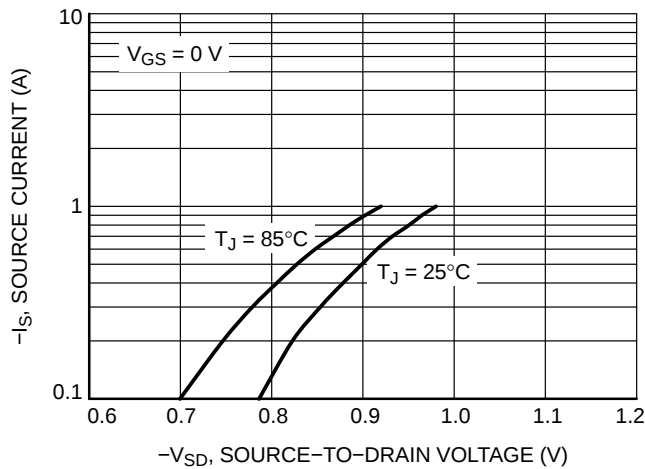


Figure 9. Diode Forward Voltage vs. Current

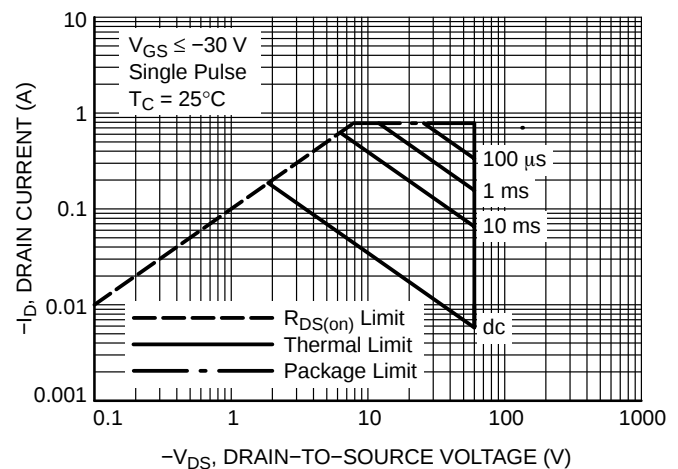


Figure 10. Maximum Rated Forward Biased Safe Operating Area

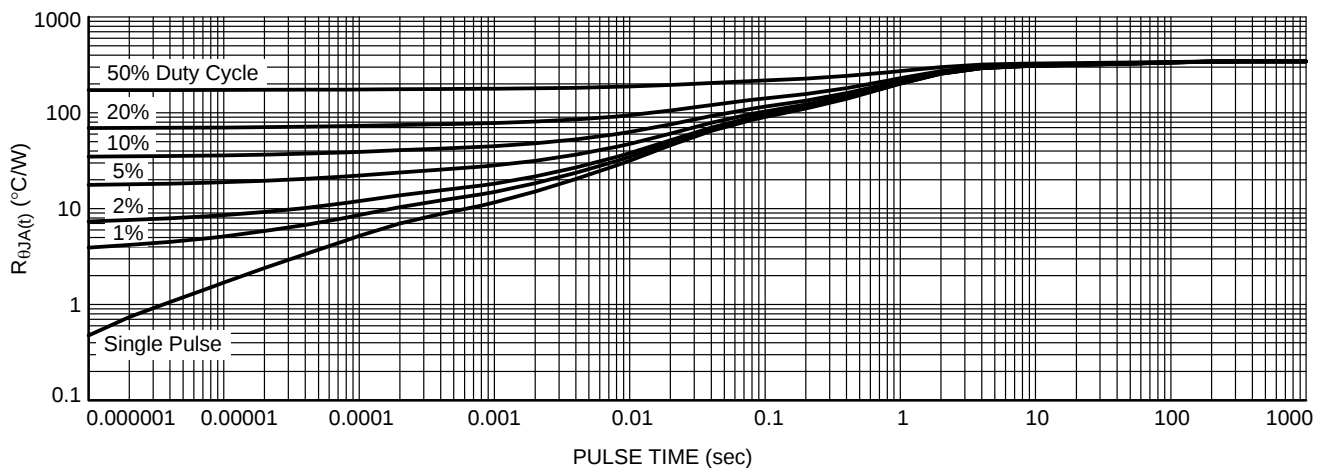
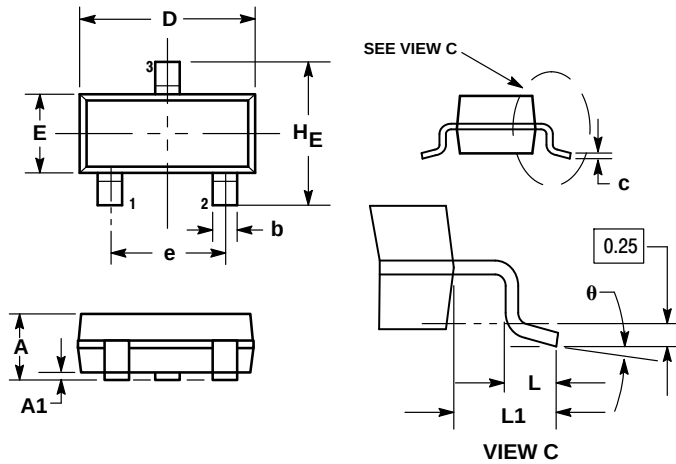


Figure 11. Thermal Response

# NTR5105P

## PACKAGE DIMENSIONS

### SOT-23 (TO-236) CASE 318-08 ISSUE AP



#### NOTES:

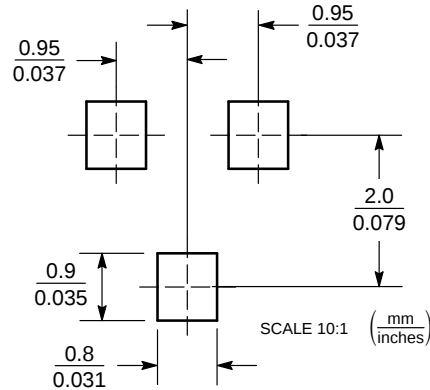
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.040 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b   | 0.37        | 0.44 | 0.50 | 0.015  | 0.018 | 0.020 |
| c   | 0.09        | 0.13 | 0.18 | 0.003  | 0.005 | 0.007 |
| D   | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E   | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e   | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.081 |
| L   | 0.10        | 0.20 | 0.30 | 0.004  | 0.008 | 0.012 |
| L1  | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.029 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| θ   | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

#### STYLE 21:

- PIN 1. GATE
- SOURCE
- DRAIN

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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